The adoption and impact of an improved groundnut variety in mixed crop-livestock systems in Southern India

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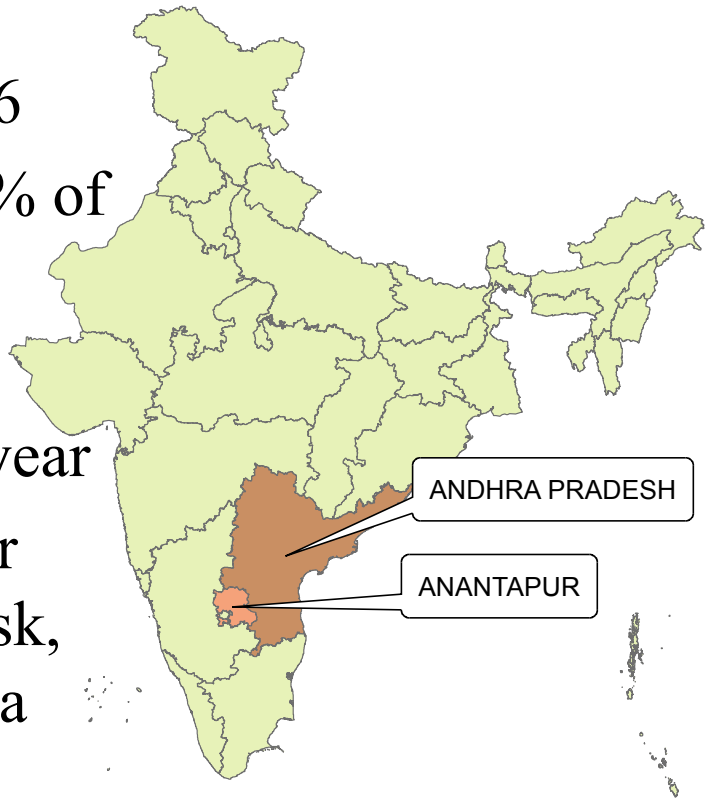
Asian Society of Agricultural Economics
Oct 13-15, Hanoi

Outline

- Background on study site and varietal development program
- Sample selection
- Characteristics of households
  - Farming systems
  - Groundnut varietal use
- Discussion
- Impact of variety on net revenue and productivity
- Discussion

Background-Anantapur

- Pop 3.6 million; 75% rural
- Named among 250 “most backward districts” in 2006
- Groundnuts planted on 80% of cropped area (800,000 ha)
- Yields are low: .27t/ha)
- Average rainfall: 550mm/year
- Livestock are important for income and coping with risk, and groundnut haulms are a major source of feed



ICGV91114

- Despite the importance of groundnut, farmers have been reluctant to replace their traditional variety (TMV2) with improved cultivars
- ICGV91114 was developed by ICRISAT, ILRI and partners for drought-tolerance, yield (pods & haulms) and quality (haulms)
- Officially released in 2006, based on data from research stations and farmers' fields
- Advantages compared to TMV2
  - 15% increase in pods and haulms
  - Cows fed on ICGV91114 gave 0.5 lt more milk per day

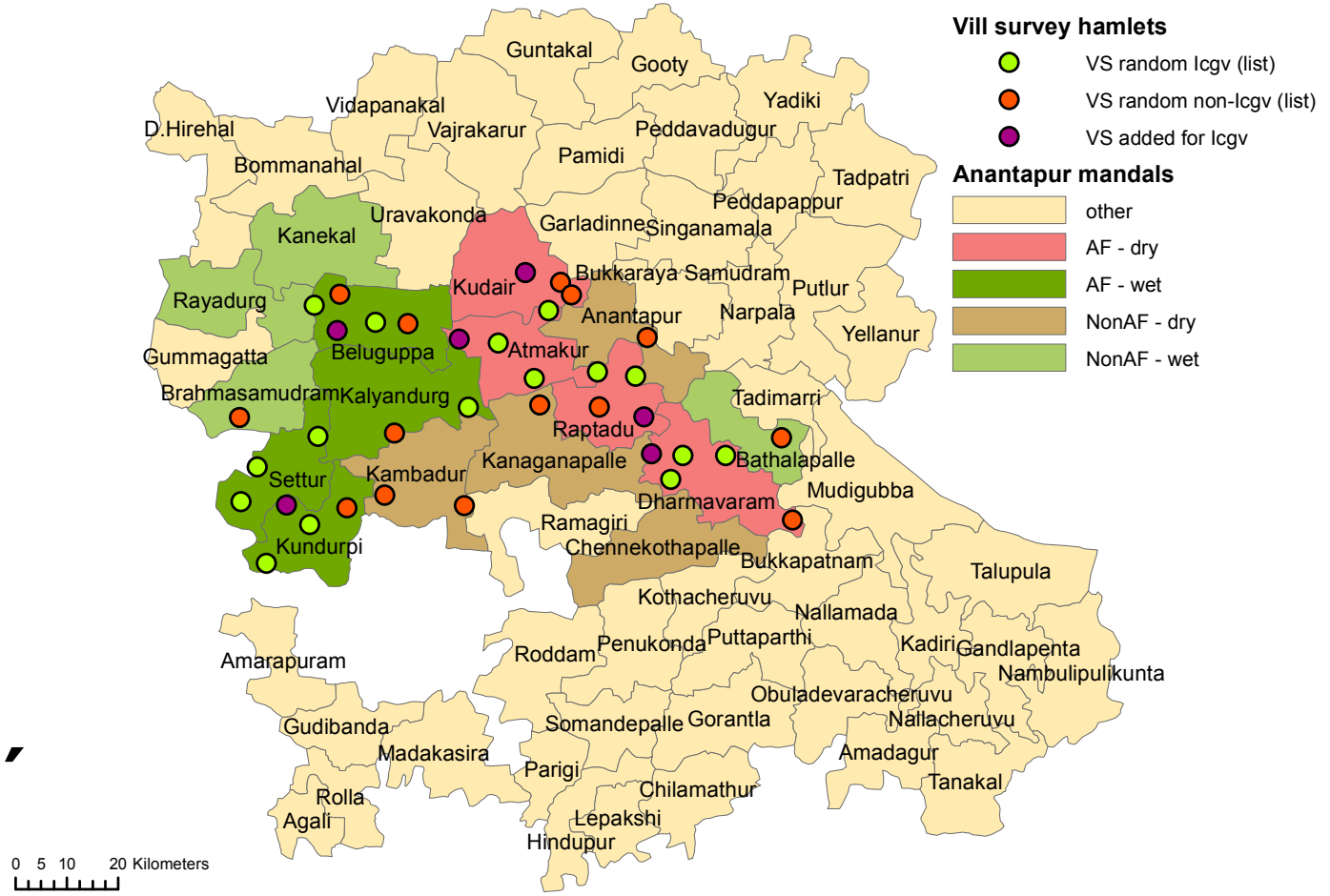
ICGV91114

- Promoted by Accion Fraterna, a local NGO involved in the varietal development, via farmer-to-farmer sales
- Estimates of dissemination to date:
  - 285 ha in 2005
  - 10,000 ha to 12,000 ha in 2009 (1.5% total area)
  - 25,000 ha in 2011 (3.1% total area)

Objectives of the study

- **Estimate the adoption and impact of ICGV91114 on crop and livestock productivity**
- Assess gender and intra-household implications
- Understand adoption pathways and dynamics
- Assess influence of crop-livestock interactions on breeding and dissemination

Location of study and sampling frame



Adoption of ICGV91114 based on Village Census

hamlet category		random selection			purposive
		AF mandal ICGV-hamlet	AF mandal non ICGV-hamlet	nonAF mandal nonICGV-hamlet	selection ICGV-hamlet
hamlet	[no.]	16	8	6	6
ICGV91114 share of groundnut area	[%]	0.5	0.1	0.0	7.8
ICGV91114 area	[ha]	40.4	2.8	0.2	139.8
ICGV91114 share of groundnut growing hh	[%]	0.3	0.1	0.1	9.4
ICGV91114 growing hh	[no.]	11	2	1	66

Source: Village census

Mean values of selected household characteristics in sample hamlets

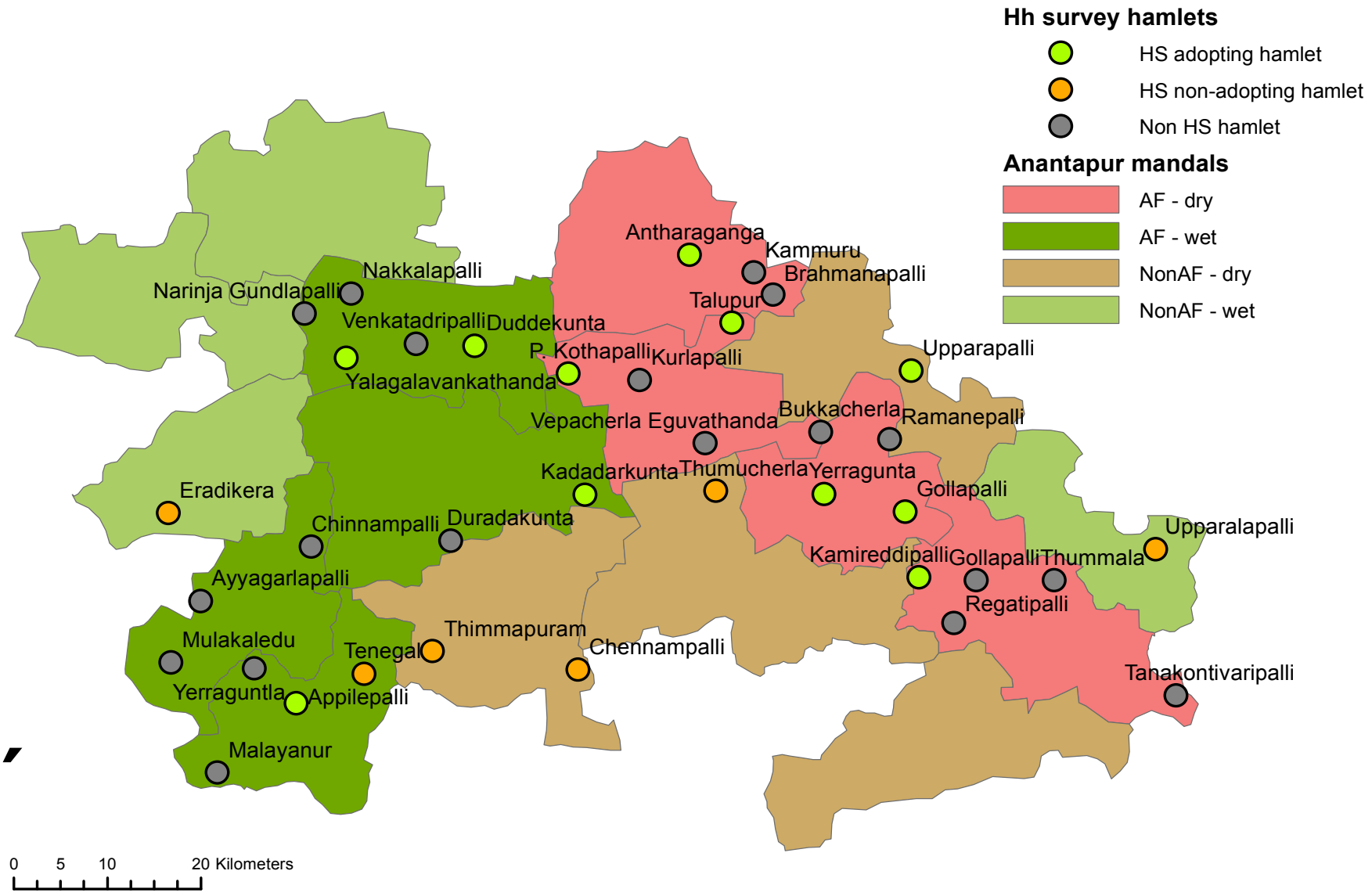
Adoption status of ICGV 91114		Adopters	Non-adopters, adopting hamlets	Non-adopters, non-adopting hamlets
Households	[no.]	75	2294	5357
Age Hh head[1]	[y]	45.0	45.9	46.7
Hh size	[no.]	4.9	4.7	4.6
Land owned	**[ha]**	5.2	2.7	2.6
Land cultivated	**[ha]**	5.3	2.6	2.6
Groundnut area	[ha]	3.6	2.2	2.2
ICGV91114 area	[ha]	2.1	0.0	0.0
Dairy cattle, local	[no.]	0.5	0.7	0.6
Dairy cattle, cross-bred	**[no.]**	0.7	0.2	0.1
Buffalo	**[no.]**	1.2	0.3	0.4
Donkey	[no.]	0.0	0.0	0.0
Goat	**[no.]**	0.1	0.6	0.6
Sheep	**[no.]**	0.4	3.3	2.7
Draft animals	**[no.]**	1.5	0.7	0.7

Source: Village census

Results of sample selection using propensity score matching (PSM)

		Adopters	non-adop., adop. Hamlet	non-adop, non-adop. hamlet
LandCultAc	unmatched	13.07	4.97	4.83
	ATT	13.07	13.32	10.76
LandOwnAc	unmatched	12.89	5.23	5.03
	ATT	12.89	13.69	11.18
CtlLcl	unmatched	0.49	0.59	0.37
	ATT	0.49	0.36	0.47
Draft	unmatched	1.51	0.58	0.59
	ATT	1.51	1.41	1.75

Location of selected hamlets by household survey category



Mean value of selected demographic characteristics and assets

	Adopters (n=80)	Non-Adopter AH (n=91)	Non-Adopter non-AH (n=102)
	Mean	Mean	Mean
Age of hh head [y]**	46.0	51.0	50.2
Edu of hh head [y schooling]***	6.6	4.7	4.2
Hh size [no.]	5.4	5.0	5.6
Labor available (15-59 years) [no.]	3.6	3.4	3.6
Cultivated land owned [ha]	5.7	5.4	5.0
Cultivated irrigated land [%]***	34	19	15
Cattle local [no.]	0.5	0.4	0.4
Cattle xbreed [no.]***	0.5	0.3	0.0
Buffalo local [no.]	0.7	0.8	1.2
Buffalo improved [no.]***	0.2	0.0	0.0
Total Adult animals [TLU]	4.2	3.5	4.4
Non-agri asset index 2008	50.5	30.0	35.5
Agri asset index 2008	373.6	254.7	269.5

Source: Household survey

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Total Adult animals [TLU]	4.2	3.5	4.4
Non-agri asset index 2008	50.5	30.0	35.5
Agri asset index 2008	373.6	254.7	269.5

Source: Household survey

Mean values of key performance and welfare measures of households

	Adopters (n=80)	Non-Adopter AH (n=91)	Non-Adopter non-AH (n=102)
Milk production [l/d]***	3.5	2.6	1.6
Milk marketed [%]***	52	33	26
Annual income [INR]	173,955	112,295	138,028
Crop income [INR]	125,886	63,987	62,626
Livestock income [INR]	25,045	19751	13,307
Annual Food Expenditure [INR]**	36,994	32,342	32,716
Annual Non-Food Expenditure [INR]	65,514	63,008	58,955
Non-agri asset index 2011	81.2	47.0	50.5
Agri asset index 2011***	493.3	303.2	279.9
Change in agri-assets index***	119.8	48.5	10.4
Change in non agri-asset index*	30.8	17.0	15.0

Source: Household survey

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Source: Household survey

Distribution of area and households under different crops by households' ICGV91114 status in that season

	Rabi (2009-10)						Kharif (2010)					
	planted ICGV91114		no ICGV91114 (adopting hamlet)		no ICGV91114 (non-adopting hamlet)		planted ICGV91114		no ICGV91114 (adopting hamlet)		no ICGV91114 (non-adopting hamlet)	
	area 29ha [%]	hh n=15 [%]	area 97ha [%]	hh n=71 [%]	area 92ha [%]	hh n=70 [%]	area 319ha [%]	hh n=56 [%]	area 598ha [%]	hh n=115 [%]	area 492ha [%]	hh n=102 [%]
Groundnut	62	100	35	42	21	29	84	100	81	98	89	100
Paddy	20	47	33	61	46	69	10	68	8	49	8	45
Other cereals	0	0	6	11	5	9	0	2	2	6	0	3
Pulses	0	0	1	1	0	0	3	9	5	6	1	3
Fruits	18	13	21	17	20	6	2	7	4	13	1	2
Vegetables	0	0	2	3	3	9	0	4	0	3	0	2
Other	0	0	2	3	5	6	0	5	1	6	0	2

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Vegetables	0	0	2	3	3	9	0	4	0	3	0	2
Other	0	0	2	3	5	6	0	5	1	6	0	2

No major differences in cropping pattern in Karif

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Fruits	18	13	21	17	20	6	2	7	4	13	1	2
Vegetables	0	0	2	3	3	9	0	4	0	3	0	2
Other	0	0	2	3	5	6	0	5	1	6	0	2

Adopters plant more groundnut in rabi

Area and household distribution of various groundnut varieties by households' ICGV91114 status in that season

	Rabi (2009-10)						Kharif (2010)					
	planted ICGV91114		no ICGV91114 (adopting hamlet)		no ICGV91114 (non-adopting hamlet)		planted ICGV91114		no ICGV91114 (adopting hamlet)		no ICGV91114 (non-adopting hamlet)	
	area 18ha [%]	hh n=15 [%]	area 34ha [%]	hh n=30 [%]	area 20ha [%]	hh n=20 [%]	area 268ha [%]	hh n=56 [%]	area 481ha [%]	hh n=113 [%]	area 436ha [%]	hh n=102 [%]
ICGV 91114	90	100	0	0	0	0	57	100	0	0	0	0
TMV2 (local)	3	7	61	57	74	80	32	38	80	84	92	90
K6	7	7	37	37	26	20	10	23	17	27	6	12
JL24	0	0	1	3	0	0	1	2	3	5	1	1

Kharif –adopters plant much less TMV2 than non-adotpers and a little less K6
AF villages more K6

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ICGV 91114	90	100	0	0	0	0	57	100	0	0	0	0
TMV2 (Local)	3	7	61	57	74	80	32	38	80	84	92	90
K6	7	7	37	37	26	20	10	23	17	27	6	12
JL24	0	0	1	3	0	0	1	2	3	5	1	1

Rabi – More improved varieties; adopters plant mostly ICGV

Grain and haulm yield [t/ha] of different crops by households' ICGV91114 status in that season

	Rabi (2009-10)						Kharif (2010)					
	planted ICGV91114		no ICGV91114 (adopting hamlet)		no ICGV91114 (non-adopting hamlet)		planted ICGV91114		no ICGV91114 (adopting hamlet)		no ICGV91114 (non-adopting hamlet)	
	grain	haulm	grain	haulm	Grain	haulm	grain	haulm	grain	haulm	grain	haulm
ICGV 91114	1.7	2.7					0.9	1.9				
TMV2 (local)	2.1	1.2	1.2	2.3	0.9	3.7	0.3	1.3	0.3	1.1	0.3	1.2
K6	0.5	2.9	1.3	3.0	2.9	4.3	0.5	1.7	0.5	1.3	0.9	2.1
JL24			1.4	4.0			0.5	1.3	0.2	1.1	0.1	0.5

Kharif – ICGV91114 better than TMV2 and usually better than K6

Rabi – not as clear

Source of seed by variety (%)

	ICGV 91114 (n=80)	K6 (n=69)	TMV2 (n=206)	JL24 (n=8)
Farm saved	20	6	7	0
Exchange	0	3	0	0
Purchase from other farmers	54	35	18	38
Purchase from market	4	0	1	0
Provided by promoting agency/NGO	21	0	0	0
Provided by govt. organisations	1	57	73	63

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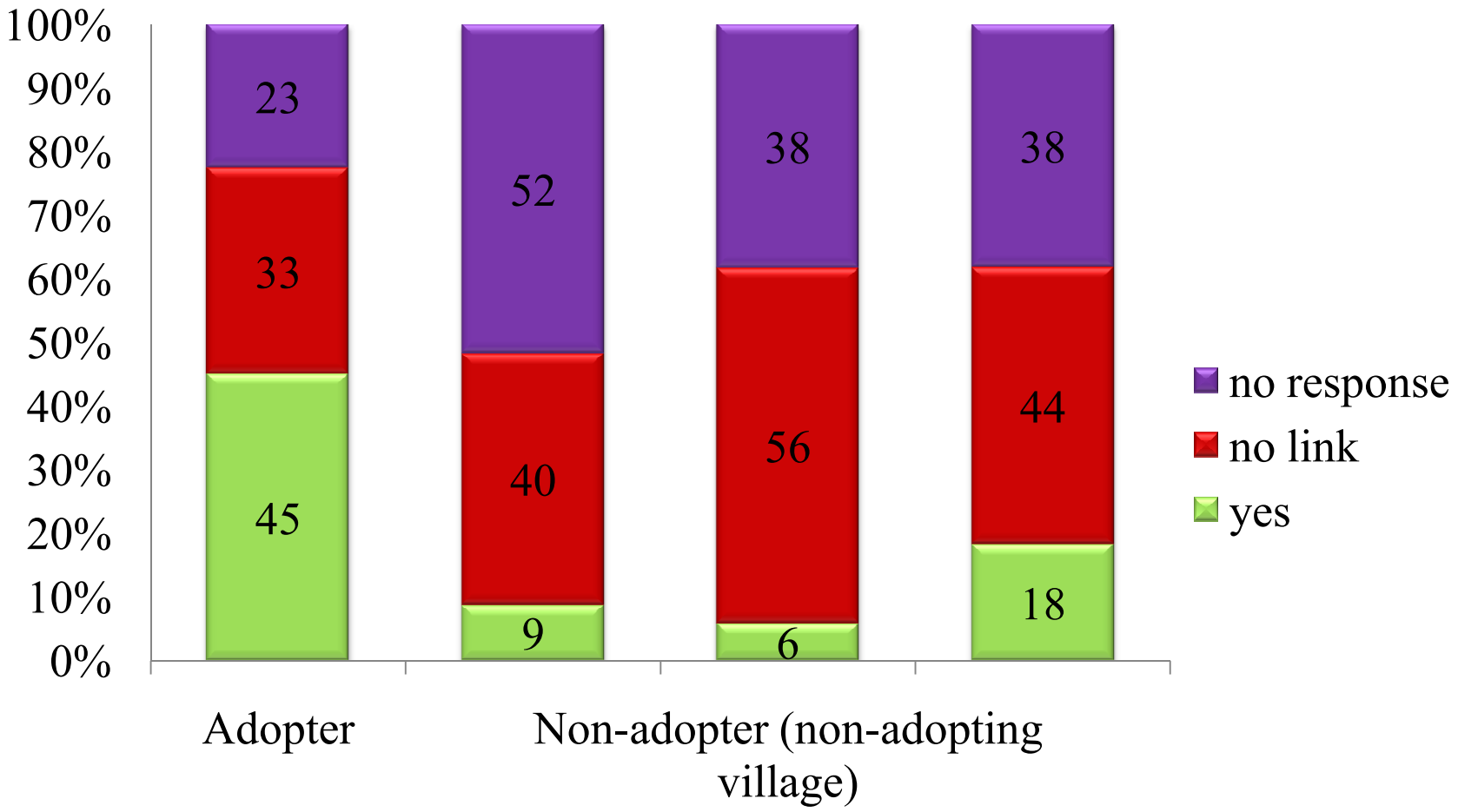
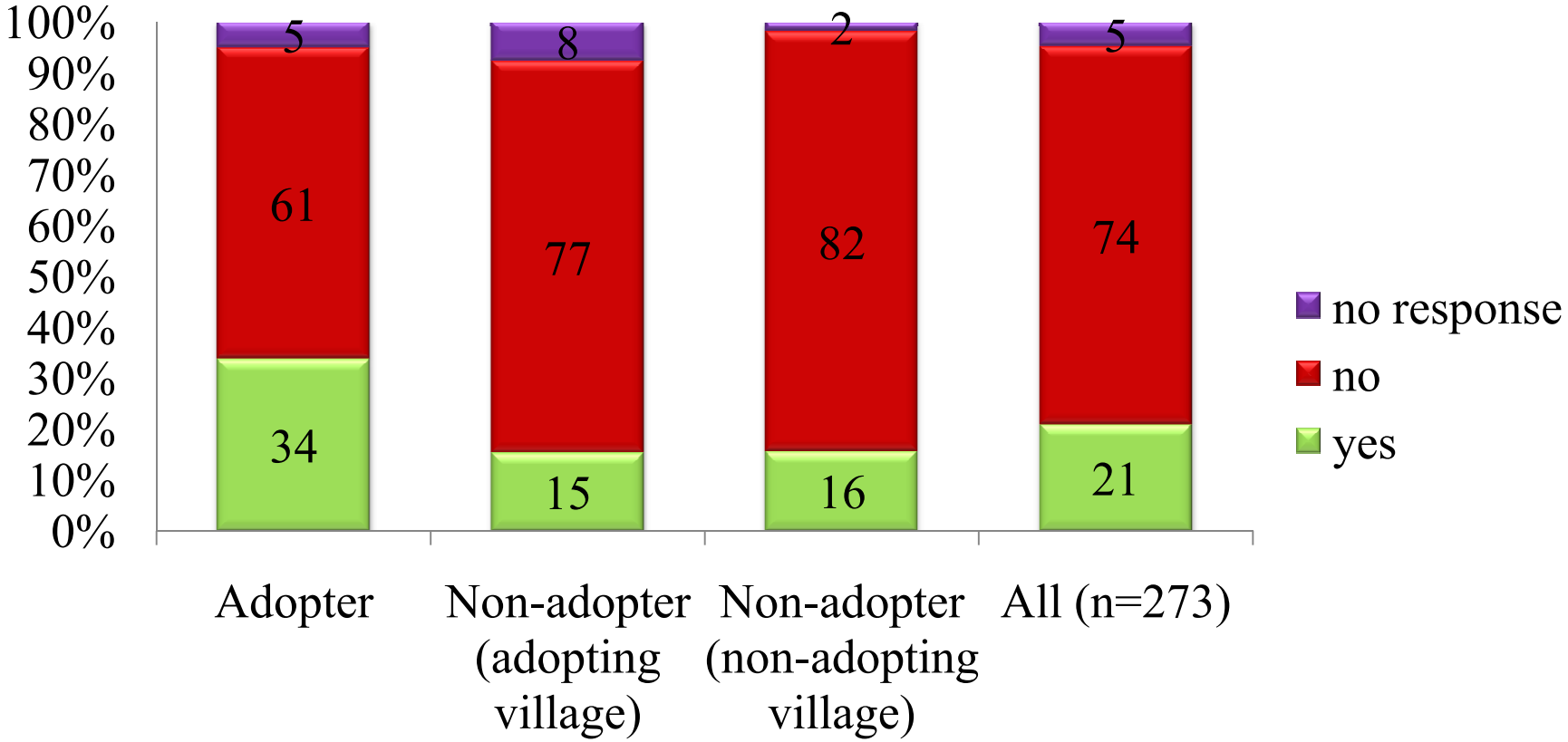
Distribution of households [%] reporting links to AF



Distribution of households [%] reporting a role of institutional support in their decision on groundnut variety



Use of pods and haulms

- Pods
  - Most are sold to traders to be processed for oil
  - Some are sold for seed, kept for seed and used for home consumption
  - Price premium for ICGV9114
- Haulms
  - Most neither purchased nor sold
  - Of those who did, more purchased than sold
  - No price premium for ICGV91114 haulms

Haulm purchases and sales

	adopters		non-adopters (adopting hamlet)		non-adopters (non-adopting hamlet)	
	purchased	sold	purchased	sold	purchased	sold
quantity [t]	2.1	0.7	3.4	2.8	2.7	1.7
price [rs/t]	1,990	1,429	1,728	1,596	1,569	1,688
hh [no.]	15	1	29	8	38	11

Value of output, yield and cost of cultivation of ICGV91114, TMV2 and K6 by season

	Rabi (2009-10)			Kharif (2010)		
	ICGV 91114	TMV2	K6	ICGV 91114	TMV2	K6
Hh growing [no.]	15	34	16	56	208	55
Outputs						
Value of production[Rs/ha]	64,398	26,835	52,480	21,810	7,440	17,014
pod yield [t/ha]	2.12	0.97	1.72	0.68	0.25	0.53
haulm yield[t/ha]	2.84	2.44	3.41	1.58	0.98	1.50
Input costs [Rs/ha]						
seeding/planting	677	615	868	626	393	589
seed	7,310	5,221	7,741	5,032	3,850	5,268
irrigation	102	101	130	19	2	24
fertiliser	1,079	2,066	2,874	1,251	793	1,263
manure	1,354	1,529	1,813	2,057	1,282	1,917
weeding	1,746	1,977	1,632	1,522	1,229	1,757
pesticides	1,098	1,106	1,096	818	427	652
harvesting/threshing	3,081	2,002	2,577	1,379	908	1,485
other	-	-	-	-	55	44
Total [Rs/ha]	16,447	14,617	18,731	12,704	8,938	13,001
Net revenue[Rs/ha]	**47,951**	**12,217**	**33,749**	**9,107**	**-1,499**	**4,013**

Results of production function estimation
(dependent variable: value of production-pods + haulms, n=421)

Independent variables	**Sign and significance**
Production costs	
Irrigation, fertilizer	+++
Planting, seed, manure, weeding, other	
Demographics (age, education)	
Land cultivated	--
% irrigated land cultivated	+++
Rabi dummy	+++
TMV dummy	---
K6 dummy	
JL24 dummy	--
Non-adopter in adopting hamlet	
Non-adopter in non-adopting hamlet	

Results of production function estimation (dependent variable: milk yield (litres/cow/day; n=175)

Independent variables	**Sign and significance**
Purchased fodder	++
Purchased concentrate	
% of milk marketed	+++
% Buffalo in herd	
% Improved animals in herd	+++
Demographics (age, education)	
Land Cultivated	
% irrigated land cultivated	
Non-adopter in adopting hamlet	
Non-adopter in non-adopting hamlet	

Conclusions

- Adoption of ICGV91114 generates significant economic benefits, including to small farmers, yet despite recent growth, few households are adopting it.
- Some possible reasons include:
  - ***Seed systems***. The fact that it is not in the public distribution system makes it more costly to obtain, however a significant number of farmers get other improved varieties from farmer-to-farmer dissemination, and seed cost is not higher for 91114 compared to K6. Lack of links to public credit and insurance system cold be more important (see below)
  - ***Early stages of dairy intensification*.** Evidence suggests that feed quality only becomes important in later stages of intensification process. The haulm characteristics are not yet widely appreciated; farmers plant it for pod yield and market doesn't reward quality traits.
  - ***Role in risk management.*** ICGV91114 is drought tolerant, but for vulnerable farmers seeking to minimize risk this is a difficult message to communicate ,and in any case they might be better off relying on government crop insurance systems.
- Some implications
  - Strengthening farmer to farmer system could encourage dissemination of ICGV91114 and others improved varieties
  - Different characteristics of the variety might appeal to different audiences=> targeted dissemination eg to dairy farmers